King County Regional Infiltration/Inflow Control Program
Local Agency Workshop #9 Summary
Tuesday, January 14, 2003

Background

The King County regional wastewater treatment system includes wastewater interceptors, pump stations, treatment plants and outfalls. Thirty-four politically and administratively independent Local Agencies discharge wastewater from their systems to King County's regional wastewater system. Increased wastewater flows within this vast service area have used significant portions of, and in some cases have exceeded, the capacity of existing County facilities.

The Regional Wastewater Services Plan (RWSP) directs the County and the Local Agencies to take action on several components of the wastewater system including new treatment, combined sewer overflows, water reuse, and infiltration and inflow (I/I). To comply with the portion of the RWSP that requires I/I to be addressed, the County, in conjunction with the Local Agencies, began the Regional I/I Control Program. A cornerstone of the I/I Control Program is active involvement of Local Agencies in a consensus-based process that relies on a coordinated, collaborative approach to develop components of the I/I Control Program. The I/I Control Program includes:

- Extensive flow monitoring and modeling
- I/I removal pilot projects
- Development of standards, procedures, and policies
- Assessing cost effectiveness of I/I reduction
- Developing a Regional I/I Control Program for approval and adoption

To educate and involve the Local Agencies in these decisions and to resolve issues related to I/I, 14 participatory workshops have been scheduled at key points during the I/I Control Program. To date, nine workshops have been held to:

- introduce participants to the issues
- address technical, financial, and cost sharing issues
- determine criteria for pilot basin/project selection
- select pilot basins/projects
- describe modeling of wastewater flows
- identify key issues related to standards, procedures and policies for I/I control projects.

Local Agency Workshop #9 was held on Tuesday, January 14, 2003 at the Red Lion Bellevue Inn in Bellevue, Washington from 8:30 AM to 12 Noon.

Workshop Purpose

The intent of I/I Control Program Workshop #9 was threefold: to describe work done to date on determining and designing the ten pilot projects chosen by the Local Agencies at Workshop #8, to update Local Agency representatives on the results of Sewer System Evaluation Surveys (SSES) for the pilot projects, and to review pilot project schedules. There was also a general update on the I/I Control Program, including status of the Metropolitan Water Pollution Abatement Advisory

Committee (MWPAAC) RWSP Subcommittee's review of the standards, procedures and policies proposed for use and testing in the pilot projects.

Welcome & Introductions

Don Theiler, Manager, King County Wastewater Treatment Division

Mr. Theiler, King County's Wastewater Treatment Division Manager, welcomed attendees and expressed appreciation for the hard work of the MWPAAC RWSP Subcommittee over the course of 2002 in developing the draft I/I Standards, Procedures and Policies. Mr. Theiler reiterated that King County intends to continue its support for the I/I Control Program, one of the most comprehensive and advanced efforts of its kind in the nation. He noted that the pilot projects under discussion at this Workshop would be critical in identifying what I/I control measures would and would not be cost effective. He also commended the cooperation on I/I Control Program issues that has developed over time between King County and the Local Agencies.

Dave Christensen, City of Renton, MWPAAC Chair

Dave Christensen, Chair of MWPAAC, updated attendees on the status of the I/I Standards, Procedures and Policies ("the standards"). Mr. Christensen emphasized that the standards had been developed using a cooperative approach where all impacted agencies in the region had the opportunity to participate. He observed that the MWPAAC RWSP Subcommittee had put an immense amount of work into developing standards that were acceptable to the Local Agencies and King County, and also to MWPAAC as a whole and to the Regional Water Quality Committee (RWQC). He added that MWPAAC and the RWQC had recommended to the King County Executive that the standards be adopted and tested for effectiveness in the pilot projects.

I/I Control Program Status & Schedule

Dan Sturgill, Regional I/I Control Program Manager, King County

Mr. Sturgill, I/I Control Program Manager, thanked MWPAAC RWSP Subcommittee members for their hard work on the standards before giving a brief update on the I/I Control Program status and schedule. He noted that work is under way on the ten pilot projects selected by the Local Agencies at Workshop #8 in April 2002, and that a third round of flow monitoring is slated for next year's wet season to measure the effectiveness of I/I control in the pilot project areas.

Mr. Sturgill also reported that the request last year for $9 million in federal funding to support additional pilot projects was not granted, nor was a downsized request for $7 million. Efforts to secure future funding will be evaluated as the I/I Control Program continues.

Mr. Sturgill explained that the next I/I Control Program Workshop is scheduled for April 2004, more than a year away, and asked attendees to fill out a questionnaire to let King County know how their Agencies would like to be updated on the I/I Control Program in the interim. He then briefly reviewed the agenda for Workshop #9, which focused on the details of each pilot project and an update on the standards.

Overview of I/I Control Pilot Project Approach

Ed Pier & Barry Scott, Earth Tech Team

Mr. Scott reviewed the purposes of the I/I control pilot projects:

- To provide information to assist in determining if I/I removal is cost effective

- To demonstrate and test the effectiveness of different techniques for I/I removal
- To provide models for successful future projects
- To test the standards

He then used a diagram to provide an overview of a pilot basin, flow monitoring basin, and control basin area. Separate control basin areas were established adjacent to the repair areas in six of the pilot projects – each similar in size to the area where repairs will be done. The control basins will be monitored for flows in wet weather next winter to compare the flows in the area where the system was rehabilitated to an area that had not been repaired.

Mr. Scott then provided some data explaining that most I/I in the region comes from several small leaks, not huge structural defects in the system. For example, a kitchen sink faucet left running would contribute about a gallon per minute of inflow to the wastewater treatment system; this would add up to 1,440 gallons per day over a 24-hour period. A flowing garden hose will discharge about 5 gallons per minute, or 7,200 gallons over the course of a single day. The average roof drain contributes about 6 gallons per minute during rainy weather, which would add up to 8,640 gallons per 24 hours. There are usually four houses per acre in most municipalities in this region, where the threshold for excessive I/I is 1,100 gallons per acre per day.

Ed Pier explained that the primary objective of SSES work was to find the sources of I/I so the design team could devise appropriate system rehabilitation techniques. He described how project engineers went about the task of finding all these small leaks by using various SSES methods. These general techniques are summarized in the table below for the three general types of I/I: inflow, rapid infiltration, or base infiltration.

I/I Category	Primary Source	Rehabilitation Approach

Inflow	• Connection to surface runoff
	  ○ Roof leaders
	  ○ Storm sewers
	  ○ Cleanouts
		• Disconnects
		• Seal manhole covers
		• *Relative cost - $*

Rapid Infiltration	• Damaged laterals/side sewers	• Replace or repair laterals, side sewers
		  ○ Pipe bursting
		  ○ Dig and replace
		• *Relative cost - $$*

Infiltration	• Groundwater or trench flow
	  ○ Cracked or broken main or manhole
		• Pipe or manhole lining
		• Replace or repair pipe or manhole
		  ○ Pipe bursting
		  ○ Dig and replace
		• *Relative cost - $$$*

Evaluation Process

To ascertain whether excess flows are due to inflow, rapid infiltration or base infiltration, the project team examines the hydrograph produced by flow metering last year. Very sharp peaks or spikes in the hydrograph indicate inflow. When the amount of flow tails off slowly after such a storm spike it is usually due to rapid infiltration. A slow rise in the base level of flow over time indicates base infiltration.

When the hydrograph shows inflow, SSES work begins with smoke and dye testing for illicit connections and continues with closed circuit television (CCTV) inspection of side sewers. When the hydrograph depicts rapid infiltration, SSES work begins with CCTV of side sewers and then moves to smoke and dye testing before concluding with manhole inspections. SSES work to pinpoint base infiltration sources starts with CCTV inspection of the mainline coupled with manhole inspection, continues with side sewer CCTV, and concludes with pressure and/or vacuum testing. If a hydrograph shows all three types of I/I, SSES work includes a combination of methods: mainline CCTV, manhole inspection, and smoke and dye testing followed by flow modeling.

I/I pilot project engineers documented defects in the various systems using digital photos and videos from visual and CCTV inspections. The results were compiled in a tabular database. The project team developed a coding system for specific defects, informed by codes developed by the Water Resources Center in Britain (WRc) and the National Association of Sewer System Companies (NASSCO) in the US. Pipes and manholes were also given a structural rating from 1 to 5 to depict their condition:

Rating of 1 = Good condition
Rating of 2 = Acceptable condition, with the potential for future degradation
Rating of 3 = Some defects; no major structural problems
Rating of 4 = Significant deterioration
Rating of 5 = Severe deterioration

Pipes and manholes rated 1 or 2 are not in need of repair, while those rated 3, 4 or 5 should be rehabilitated if at all possible.

After entering all this information into the database, including data related to locations where smoke testing showed direct stormwater connections to the sanitary sewer system, the project team generated maps using geographic information system (GIS) software. These maps showed concentrations of pipe and manhole defects that inform and support the concentration of repair efforts in certain areas.

Specifics of Each Pilot Basin/Project

Mr. Pier and Mr. Scott then conveyed specific information about each of the ten pilot projects in turn, including:

- Review of general pilot characteristics (from April 2002 workshop when Local Agencies selected pilots)
- Hydrograph from 2001-2002 wet season flow monitoring
- Map of defects
- SSES ratings, or number of defects rated 3, 4 or 5
- Reason for selecting pilot project area
- Map of planned repairs
- Details of repair techniques
- Projected I/I reduction
- Cost estimate

Please refer to the attached printout of the Workshop #9 slides for maps and hydrographs of each pilot. Information on specific repairs, costs, and projected I/I reduction is included. For several pilot projects (noted below), a control basin will be established, similar in size and characteristics to the pilot basin, to measure the relative improvement in flow reduction during next winter's wet season.

PILOT PROJECT DETAILS

Manhole Repair Combined Pilot: Coal Creek, Northshore, Val Vue

- Rehabilitate ~200 manholes
- Techniques include:
    - Spot repairs
    - Interior coatings
    - Pipe penetrations
    - Leveling ring replacement
- Projected I/I reduction: 20%
- Cost estimate: $750,000

Auburn Pilot Project

- Rehabilitate private sewer mains (Auburn Adventist Academy) with open cut or pipe bursting
- Eliminate direct surface water inflow into manholes using pans under lids
- Disconnect illegal inflow connections
- Projected I/I reduction: 30%
- Cost estimate: $325,000

Brier Pilot Project (allows for both pilot and control basin)

- Rehabilitate portions of main by lining
- Repair ~20 service connections by lining
- Repair manholes through spray-on coating or cure-in-place liner
- Projected I/I reduction: 40%
- Cost estimate: $500,000

Kent Pilot Project (allows for both pilot and control basin)

- Rehabilitate laterals and side sewers by cure-in-place lining
- Potential exists for open cut of shallow side sewer in combination with cure-in-place lateral
- Projected I/I reduction: 70%
- Cost estimate: $992,000

Kirkland Pilot Project (allows for both pilot and control basin)

- Rehabilitate mains, service connections, laterals and side sewers by pipe bursting
- Expand 6” mains to 8” (funded by City of Kirkland)
- Manholes
    - Replace
    - Interior coatings – will use various types to test effectiveness
- Projected I/I reduction: 30%
- Cost estimate: $986,000

Lake Forest Park Pilot Project

- Rehabilitate main and service connections by cure-in-place lining
- Rehabilitate mains using cure-in-place spot repairs
- Rehabilitate manholes with spray-on interior coatings
- Adjust/replace rings and covers
- Projected I/I reduction: 50%

- Cost estimate: $900,000

Mercer Island Pilot Project (allows for both pilot and control basin)
- Rehabilitate mains by lining
- Rehabilitate defective service connections
- Projected I/I reduction: 25%
- Cost estimate: $700,000

Redmond Pilot Project (allows for both pilot and control basin)
- Rehabilitate mains, service connections and laterals by lining
- Rehabilitate manholes with interior coatings and spot repairs
- Projected I/I reduction: 50%
- Cost estimate: $900,000

Ronald Pilot Project
- Rehabilitate selected mains by trenchless spot repairs
- Rehabilitate service connections, laterals and side sewers by pipe bursting
- Projected I/I reduction: Not Available
- Cost estimate: $1,800,000
    - Agency: $900,000
    - King County: $900,000

Skyway Pilot Project (allows for both pilot and control basin)
- Rehabilitate mains, service connections and laterals by pipe bursting and other techniques, as necessary
- Replace manholes
- Projected I/I reduction: 70%
- Cost estimate: $2,400,000
    - Agency: $1,500,000
    - King County: $900,000

Pilot Project Technologies
Mr. Scott provided an overview of the wide range of different technologies that will be employed in the pilot projects to gauge their effectiveness and relative cost.

Manhole Repair Technologies

	Coal Creek	Northshore	Val Vue	Brier	Kirkland	Lake Forest Park	Redmond	Skyway
Replacement					**X**			**X**
Pan Under Lid	**X**	**X**	**X**					
Interior Coating	**X**	**X**	**X**	**X**		**X**		
Spot Repairs	**X**	**X**	**X**	**X**	**X**		**X**	
Pipe Penetrations	**X**	**X**	**X**	**X**			**X**	
Structural Repairs			**X**					

Mainline Repair Technologies

	Auburn	Brier	Kirkland	Lake Forest Park	Mercer Island	Redmond	Ronald	Skyway
Cured-in-Place		**X**		**X**	**X**	**X**		
Pipe Bursting	**X**		**X**				**X**	**X**
Trenchless Spot Repairs		**X**					**X**	

Service Connection Repair Technologies

	Auburn	Brier	Kent	Kirkland	Lake Forest Park	Mercer Island	Redmond	Ronald	Skyway
Connections:									
Replacement		**X**		**X**	**X**				
Connection Grouting					**X**	**X**			
Cured-in-Place (CIPP)	**X**	**X**			**X**	**X**	**X**		
Connections & Laterals:									
CIPP		**X**		**X**			**X**		
Fold & Form PVC			**X**						
Pipe Bursting	**X**			**X**				**X**	**X**
Laterals Only:									
CIPP		**X**	**X**						
Fold & Form PVC			**X**						
Pipe Bursting	**X**			**X**					**X**
Disconnections	**X**			**X**		**X**			

Other Pilot Project Details: Total Costs, Contract and Construction Components, SEPA

Mr. Scott summarized the total budget for the pilot projects as follows:

- Total King County budget allocated to pilot projects: ~$9,000,000
- Total committed to date: ~$7,500,000
- Budgeted funds remaining: ~$1,500,000

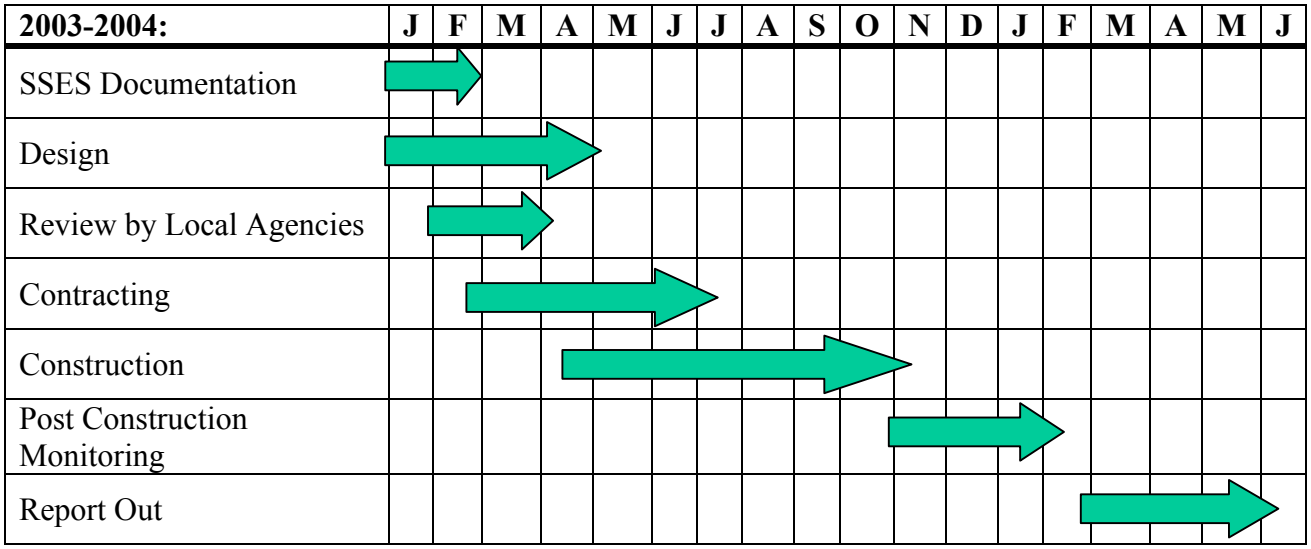
The County is also looking at possible cost efficiencies in combining pilot basin management. Skyway and Ronald are bidding and managing their own pilot projects with King County oversight. King County will manage the remaining projects. The County will advertise for contractors using trade journals, the County procurement web page and other usual outlets. There will be an open house for contractors sometime this spring.

A State Environmental Policy Act (SEPA) ruling of a determination of non-significance was issued for the Skyway project on December 11. The combined manhole repair project is categorically

exempt, since no real digging will occur. The Ronald project will have its own SEPA determination. A programmatic SEPA determination for the remaining seven projects is about 90% complete.

Pilot Project Schedule

Mr. Scott then reviewed the schedule for the pilots:



Questions and Responses

Q: Is the estimated reduction of I/I for the pilot basin, or for the entire monitoring area? And is it a reduction of peak flow, or total volume at treatment plant?

R: The percent removal estimate is for the pilot project area only in cases where specific pilot and control basin areas have been delineated. For those pilot projects without control basins, the percent removal is for the entire basin. The estimate is for reduction in the amount of I/I during both peak and average flows. The post-flow monitoring should differentiate between the amount of reduction for peak flows and the reduction for average flows. The estimate does not refer to the total flow volume.

Q: Were there any surprises in the types of illicit connections you found?

R: One was a surface drain from a gas station, that's about it. Others were from house roof drains, broken cleanouts, and an institutional building.

Q: What is the relationship between the peak to base ratio and the gallons per acre per day (GPAD) numbers?

R: This information was originally provided to assist Local Agencies in choosing the pilots. The GPAD number is related to the system size and shows the total volume of I/I measured by flow monitoring in the 2001-2002 wet season. The peaking factor shows the severity of I/I on top of the base flows in the system.

Q: How do you go about repairing a lateral at the property line?

R: At the property line, we install a cleanout and inspect/test the lateral. Where possible, we will use trenchless technologies for repairing laterals.

Q: Are there concerns about where the water flows that are being removed from the sanitary sewer in the pilots will go?

R: If it appears that we would create local flooding as a result of an I/I control project, we will move away from that area. We are working with King County Surface Water to ensure we do not create storm water impacts, under the "do no harm" principle. Where we are working on laterals and side sewers, we are mindful of all private property impacts; these are addressed thoroughly and clearly in the recently completed standards.

Q: Do the defects identified in the pilots correlate to defects typically found in the regional system? Will we be able to identify approximate I/I reduction throughout the regional system by looking at the effectiveness of certain techniques to address specific defects?

R: The reasons for doing the pilot projects include:

- finding I/I
- removing I/I
- ascertaining the cost of removing I/I
- testing various technologies for I/I control.

The pilots were chosen by the Local Agencies according to a set of criteria, including how representative they are of regional characteristics, e.g. geo-technical, problem types, or geographically. We don't really know yet how they will apply regionally since SSES work has not been done in other parts of the regional system to confirm that similar defects do exist. Until we do some of that work and until we look at the new hydrographs after next winter to gauge the effectiveness of the pilot repairs, we can't know the extent of the pilots' applicability to the regional system. However, even with this caveat, it is expected that there will be correlations from the pilots to the whole region. The Local Agencies will be given all the information from the pilots as it becomes available, including cost estimating, cost effectiveness, and success in removing I/I. This will be the focus of I/I Control Program work (and updates) through 2003 and into 2004.

Q: In the manhole repair projects, will putting pans under the lids restrict access to the manholes?

R: First, pans or other manhole inserts will not be used where cars and trucks drive. Second, the lid pan unit we are using should not restrict access. It is stainless steel, with handles and a valve to drain off the water before removal.

MWPAAC RWSP Subcommittee Standards, Procedures and Policies

Bob Wheeler, Earth Tech Team

Mr. Wheeler began by thanking the MWPAAC RWSP Subcommittee for the immense amount of work that went into the development of the draft I/I control project standards between February and October 2002. These standards were created to meet a mandate in the RWSP (I/I Policy 2.2):

> "By December 31, 2002 the County, in coordination with component agencies, shall develop model local conveyance systems' design standards, including inspection and enforcement standards, for use by component agencies to reduce I/I within their systems."

The standards were first addressed at I/I Control Program Local Agency Workshop #6, in July 2001. From this initial Local Agency input, King County drafted a set of Standards, Procedures and Policies, met with each Local Agency to discuss both technical and policy issues before revising the draft documents, and produced a final draft for discussion at Workshop #7 in January 2002.

Local Agencies and King County agreed at Workshop #7 that the MWPAAC RWSP Subcommittee would review and refine the standards in time for the December 31, 2002 deadline. All interested Local Agency staff, managers, and elected officials were invited to participate on the MWPAAC RWSP Subcommittee as it worked with the County to develop and refine the standards in a consensus process. The standards as drafted by the Earth Tech consultant team included a range of alternatives for each item, from very aggressive I/I removal, to much less aggressive measures, to status quo. The standards for rehabilitation projects focused on new technologies, while those for new projects focused on inspection, testing and warranty. The valuable knowledge and experience of Local Agencies was integrated into the draft standards.

The MWPAAC RWSP Subcommittee presented the "working draft" standards to the full MWPAAC body on October 2, 2002. MWPAAC reviewed and approved the standards. In its submittal letter to King County dated October 30, 2002, MWPAAC stated that the submittal of the standards met RWSP policy requirements. It also said that the MWPAAC RWSP Subcommittee would revisit the standards after the pilot projects were completed, for valuable technical input and policy lessons learned, to improve the standards for final revision and inclusion in the King County Executive's recommended long-term measures to control I/I for the RWSP.

The Regional Water Quality Committee (RWQC) discussed the draft standards at its meeting on December 11, 2002. The RWQC commented positively on the final document as submitted by the Subcommittee and approved the draft standards by consensus for use in the pilot projects. The RWQC also expressed a desire for pilot project contractors to use new technologies, as the Regional I/I Control Program is a cutting edge effort and, via the pilot projects, can test a number of recently developed pipe and manhole repair techniques and products.

Wrap-up & Next Steps

Bob Wheeler, Earth Tech Team

Mr. Wheeler pointed out that I/I Control Program Workshop #10 is scheduled for April 2004 and asked Local Agency representatives to fill out a questionnaire on how their Agencies would like to be kept up to date on the I/I Control Program. He also asked for their preferences on educational methods to raise public awareness on I/I issues.

Questionnaire Results – next page (# Returned: 30)

PROGRAM UPDATE PREFERENCES

Update Method – *Listed below in order of highest preference to lowest preference*	**Ranking Scores** *(1 = highest; 5 = lowest preference. Number of respondents choosing each rank listed below)*	**Average Rank**
Electronic newsletter	18 – 1's 4 – 2's 1 – 3 3 – 4's	**1.58** Votes for e-news "every month": 6 Votes for "at key Program points": 11 *Comment:* "Possibly quarterly"
Hard copy mailing	7 – 1's 10 – 2 's 2 – 3's 1 – 4 4 – 5's	**2.46**
Smaller, "sub-regional" workshops on specific topics	3 – 1's 4 – 2's 7 – 3's 4 – 4's 1 – 5 1 – 6	**2.80**
Additional workshop to update policy makers in 2003	0 – 1's 6 – 2's 5 – 3's 5 – 4's 6 – 5's	**3.50** **Month Preferred in 2003:** • October (*2*) • September or October • July • August • When best appropriate • Any • A workshop in mid-'03 to describe past/present results
LAM/policy team members meet with each Local Agency	0 – 1's 2 – 2's 5 – 3's 5 – 4's 4 – 5's	**3.69**
Other		**Specific suggestions:** • "Reports at MWPAAC meetings" (2) • Updated web pages

Comments:

- "Keep the Agency informed at key points."
- "Keep us informed! A mid-project report on the pilot projects would help."

PUBLIC EDUCATION METHODS

Education Method – *Listed below in order of highest preference to lowest preference*	**Ranking Scores** *(1 = highest; 5 = lowest preference. Number of respondents choosing each rank listed below)*	**Average Rank**
Fact sheets distributed in pilot project neighborhoods or areas with significant I/I problems	12 – 1's 4 – 2's 2 – 3's 2 – 4's No 5's, 6's or 7's 4 – 8's 1 – 9	**2.79**
Newspaper articles in local papers	3 – 1's 10 – 2's 4 – 3's No 4's, 5's or 6's 1 – 7 2 – 8's 0 – 9's	**2.90**
King County web page updates	3 – 1's 2 – 2's 5 – 3's 5 – 4's 2 – 5's 1 – 6 2 – 7's No 8's or 9's	**3.67**
Article for community newsletter or web page	2 – 1's 2 – 2's 4 – 3's 7 – 5's 2 – 6's No 7's, 8's or 9's	**3.96**
Media kit for generating local publicity	4 – 1's 3 – 2's 1 – 4 1 – 5 1 – 6 1 – 7 3 – 8's 5 – 9's	**5.20**

King County web page link to local page	0 – 1's 1 – 2 1 – 3 4 – 4's 3 – 5's 5 – 6's 1 – 7 2 – 8's 0 – 9's	**5.24**
Joint participation by King County and Local Agencies	0 – 1's 1 – 2 2 – 3's 1 – 4 0 – 5's 6 – 6's 6 – 7's 1 – 8 1 – 9	**5.94**
King County ad program (*Daily Journal of Commerce*, *Puget Sound Business Journal*, etc.)	0 – 1's 1 – 2 1 – 3 1 – 4 4 – 5's 1 – 6 2 – 7's 1 – 8 5 – 9's	**6.38**
Talking points/ presentation for community group briefings	No 1's or 2's 3 – 3's 2 – 4's 1 – 5 1 – 6 3 – 7's 5 – 8's 2 – 9's 1 – 10	**6.50**
Other		• Local Agency link to County web site • Information to add to District's web site • Mailings from KC to go out with local agency newsletters/billings • Fact sheets for building permit centers

Votes for covering each Topic in public education efforts:

Education Topic	# of Votes	Comments
General I/I Control Program information	17	
General information about sewer and drainage system operation and maintenance	18	Fats, oils, grease
Disconnecting downspouts	17	
Other		• "As noted above, a general understanding about the sewer system – [explain:] don't put [fats, oils, rocks] into the sewer because…surcharges treatment plant during storm events" • "Value of property owner granting right of entry for work on private property" • "Answer WHY!" • "Specifics of basin I/I construction project and impacts to local property owners"

General Comments:

- Public information within pilot project area essential to achieving public awareness